SUMMARY OF THE INVENTION

The present invention provides a method and system for inputting Chinese characters into a computer. The invention improves the ease of use as well as efficiency of inputting Chinese characters over the prior art. Ease of use and efficiency are inherently conflicting goals in Chinese character input systems.

According to a first aspect of the invention, some of the 200+ components (also called radicals in the literature) used to construct Chinese characters is assigned representation by one of the letters in the English alphabet. This set of selected components is sufficient to construct any Chinese character of interest. Each Chinese character of interest to the present invention is assigned an “encoding”, being a text string in the English language, with each letter of the string corresponding to the Chinese character component as defined by the present invention. This is standard practice in the prior art. In the prior art, the input systems match a given text string against the set of encodings (the library) letter for letter. An input string that matches one in the library selects the Chinese character associated with that encoding. This technique requires the user to accurately memorize the exact encoding assigned to every Chinese character, a monumental task prone to error, confusion, and forgetting from disuse. The present invention uses a novel technique in order to reduce the amount of memorization required of the user. ~~In addition to the set of predefined encodings (the library), the present invention also defines two “equivalence” tables, a “forward” equivalence table and a “backward” equivalence table. These tables define, for each letter of the English alphabet, a set of strings which are to be considered “equivalent” to that letter during a comparison operation. When comparing an input text string against one from the library, the two strings are not simply compared letter for letter. Instead, each letter in the input string is further expanded into the set of predefined strings given by the forward equivalence table. Thus, if the letter ‘a’ is defined in the forward equivalence table as consisting of the set of strings {‘bc’, ‘def’, ‘hijk’}, then the input string “a” will match library strings “a”, “bc”, “def”, and “hijk”. This technique is applied to every letter in an input string. Similarly, the backward equivalence table is applied to all~~

~~letters in strings defined in the library. Thus, if the letter 'a' is defined in the backward equivalence table as equivalent to the set {"zy", "xwv", "utsr"}, then a library string "a" will match the input strings "zy", "xwv", and "utsr". The forward and backward equivalence tables are applied in every comparison. The net result is a substantial reduction in the amount of memorization imposed on the user. An example will more clearly illustrate this technique.~~

~~For example, the Chinese character 𣅃can be constructed by using the components "目" and "乍", or the components "目", "丿", and "𠂉", or the components "目", "𠂉", and "⺊", or the components "日", "一", and "乍". There is no standard definition as to which composition is the "official" one. In the prior art, the user must provide the exact set of components in the exact sequence as defined by the designer in order to get a match. (Some methods define multiple sequences that map to the same character but that is only done for some characters and still requires exact match of any of the predefined equivalent sequences). This practically requires the user to memorize the exact encoding for every Chinese character. In the present invention, an unlimited number of variations are allowed in describing a character construction to the input method. In the above example, any of the possible descriptions will result in identifying the character. A more detail explanation of how the matches occur follows.~~

~~"目" is itself a complete Chinese character, and also a commonly occurring component used in constructing other characters. As a character, it is composed of the components "日" and "一", and as a component, it is mapped to one of the 26 letters of the English alphabet, say 'a'. Similarly, "乍" is also itself a Chinese character but is not a component used commonly enough in the construction of other characters to warrant assignment to representation by a designated English alphabet. As a character, it is composed of the components "丿", "一", "丨", "一", and "一". Suppose the components "日", "丿", "丨", and "一" are mapped to the alphabetic letters 'o', 'j', 'i', and 'h' respectively. Thus, the character 𣅃 can be described by the encoding "ajhihh", although that's not the~~

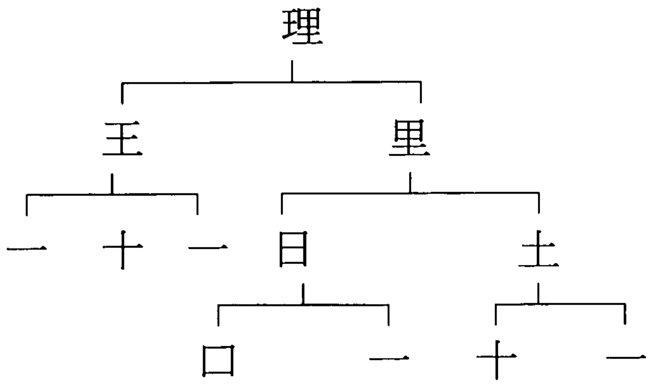
~~only possible encoding, just the one selected by the designer. However, as opposed to the prior art, the user is not required to provide this exact encoding in order to identify the character 昨. Instead, as the following table shows, the user can provide any of a number of varying input strings based on what the user perceives as the components of the character 昨, which may or may not be the same as what the input method designer has defined:~~

~~Input String~~	~~Definition~~	~~Result~~	~~Reason~~
~~ajhihh~~	~~ajhihh~~	~~match~~	~~character for character match~~
~~aaihh~~	~~ajhihh~~	~~match~~	~~the forward equivalence table defines 'a' to be equivalent to 'jh'. Therefore, the second 'a' in input string matches the 'jh' in the library encoding string, and the rest match letter for letter~~
~~ohjhihh~~	~~ajhihh~~	~~match~~	~~the backward equivalence table defines 'a' to be equivalent to 'oh'. Therefore, the 'oh' in the input string matches the 'a' in the library encoding string, and the rest match letter for letter~~
~~ohaihh~~	~~ajhihh~~	~~match~~	~~any combination of forward and backward equivalence table matching is allowed. Therefore, 'oh' matches 'a', and then 'a' matches 'jh'~~

In a first aspect of the present method, a novel technique is used to encode Chinese characters. In the prior art, each Chinese character is encoded as a string of English letters. This string is then compared to user input in order to find a match. In the present method, each Chinese character is not encoded as a string of letters, but as a data graph. This is a technique described in the Finite State Automata field of Computer Science.

According to the theories of Finite State Automata (FSA), a Chinese character can be described by a Non-deterministic Finite State Automata (NFA). An NFA is a structure which has multiple representations in multiple parts of the structure. A Chinese character is generally composed of other simpler Chinese characters. These simpler characters are in turn composed of even simpler characters, and so on, until finally indivisible strokes. This type of structure fits the definition of an NFA and all the techniques developed for NFA analysis can be applied. In the prior art, each Chinese character is reduced to a string, resulting in a loss of the inherent hierarchical structure of the character. Describing a Chinese character as an NFA preserves the inherent structure and has useful benefits.

For example, the character "理" can be represented by the following graph:



The interpretation of this graph is that the character "理" can be described by multiple sequences of components:

1. 王、里
2. 一十一里
3. 王日土
4. 王口一土
5. 王口一十一

6. 王日十一
7. 一十一日土
8. 一十一口一土
9. 一十一口一十一
10. 一十一日十一

The multiple descriptions of this character are a result of the character's inherent hierarchical structure, as depicted in the graph. Each distinct description represents a unique path of traversal through the graph. Graphs like these are typically used to describe NFA's.

The benefit to the user is a reduction in the amount of memorization required in Chinese data entry. In every graph, the leaf nodes are one of a few fundamental strokes. Therefore, a beginner user only needs to memorize these few fundamental strokes and can enter any character using just these strokes, in essence traversing the bottom level of the graphs. As the user gains experience and learns more high level components, he will gradually ascend to higher level paths throught the same graph, resulting in fewer components used in describing the same character, thus increasing typing speed.

As mentioned earlier, once characters are represented as NFA's, the techniqes of Finite State Automata theory can be applied in processing the NFA's. In particular, claim 1 describes a technique wherein a whole sub-branch in a graph can be matched to a single user input symbol by equating the symbol to a string of symbols which are the flattened contents of the sub-branch. This a technique commonly known as reducing an NFA to a DFA (Deterministic Finite State Automata).

In a second aspect of the present method, a "partial match" algorithm is used to further increase the intelligence of the encoding comparison operation. ~~In addition to allowing one or more "wildcard" characters in a given sequence to~~

~~match one or more unspecified substring of letters in an encoding,~~ Whereas explicit "wildcard" letters could be supplied by the user in an encoding, an "~~implied~~implicit" wildcard is automatically created by the present invention whenever a given input sequence does not yield any matches. ~~Thus, supposing '*' is a wildcard character, the input sequence "*jhihh" will match the encoding for 昨, but "aihh" will also match it.~~ This aspect of the present invention automatically skips over non-matching text runs within an input string while continuing to perform comparisons for matching runs, resulting in a comparison process that accepts partially matching input sequences.

In a third aspect of the present method, a novel way of resolving conflicts among characters having the same encodings is devised. Occasionally, more than one Chinese character are composed of the same exact components, the construction differing only in the relative placement of the components. To resolve these ambiguous encodings, an additional letter with a prescribed semantic of positional description is appended to each conflicting encoding. Fig. 2 contains an example illustrating this novel technique.

In a fourth aspect of the present method, a novel way of selecting characters matched by the input method is devised. Whenever more than one candidate character matches a user given letter sequence, the candidates are presented to the user for a manual selection. In the prior art, a number is sometimes used as a means of specifying the user choice. While a number is obvious in its meaning since a linear list of candidates are offered up for selection, the present invention chooses to use an alphabetic letter instead. Thus, the letter 'a' signifies choosing the first candidate, 'b' the second, and so forth. The use of an alphabetic letter instead of a number is non-obvious and has never been done in the prior art, as it is not always possible for any given input method since the alphabetic letters are used for encoding Chinese characters and may confuse the system if also used as candidate selection keys. This aspect of the present invention is significant in that it allows the user to keep his fingers on the basal touch typing position (as opposed to having to move them away to type a number), resulting in faster typing speed.

In a fifth aspect of the present method, a novel way of attaching additional information to an input string is devised. Since the present invention only employs the 26 lower case alphabetic letters in constructing input sequences, letters outside of the employed set can be and are used as carriers of additional information about the input sequence. For example, the input sequence “abc6-9” is interpreted to mean ‘match all characters defined by the encoding “abc” and with a stroke count of 6 to 9’. Another example is any input sequence beginning with an uppercase letter is defined to mean “pass through”, which means the given input sequence is made the output without interpretation, creating an efficient way of entering English sentences in the midst of Chinese characters.

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Remarks

Applicant respectfully requests that the amended Specification be accorded the same filing date as the original Specification.

Respectfully submitted,

Paul Poon

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